Case study title: **A Portfolio Approach to Natural Hazard Mitigation Policy: Santa Cruz, CA**

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Case study emphasis: Risk communication with maps using an expected value/variance decision criterion for hazards mitigation. Enable the evaluation of loss-reduction policies and strategies to assist in building sustainable communities.

Summary:

In the past, efforts to prevent catastrophic losses from natural hazards have largely been undertaken by individual property owners based on site-specific evaluations of risks to particular buildings. Public efforts to assess community vulnerability and encourage self-protection have focused on either aggregating site-specific estimates or adopting standards based upon broad assumptions about regional risks. This case study contains an alternative, intermediate scale approach to regional risk assessment and the evaluation of community mitigation policies. Properties or parcels are grouped into types with similar land uses and levels of hazard and hypothetical community mitigation strategies for protecting these properties are modeled like investment portfolios. The portfolios consist of investments in mitigation against the risk to a community posed by a specific natural hazard, and are defined by a community's mitigation budget and the proportion of the budget invested in locations of each type.

The usefulness of this approach is demonstrated through an integrated assessment of earthquake-induced lateral-spread ground failure risk in the Watsonville, California area. Data from the magnitude 6.9 Loma Prieta earthquake of 1989 are used to model lateral-spread ground failure susceptibility. Earth science and economic data are combined and analyzed in a geographic information system (GIS). The portfolio model is then used to evaluate the benefits of mitigating the risk in different locations. Different mitigation policies, one that prioritizes mitigation by land use type, another by hazard zone, and two others by different hazard identification estimation techniques are compared with the status quo policy of doing no further mitigation beyond that which already exists. For example, the portfolio representing a hazard

zone rule yields a higher expected return than the land-use rule portfolio does; however, the hazard zone portfolio experiences a higher standard deviation. Therefore, neither portfolio is clearly preferred. The two mitigation policies both reduce expected losses and increase overall expected community wealth compared with the status quo policy. Because these portfolios have been created in a GIS, other non-quantifiable information can be overlaid on the risk map to incorporate additional factors as input to the decision simulation.

Date that model application was completed: 2002

Case study geographical location: Santa Cruz County, CA

Vulnerability assessment indicators: Spatial probability of earthquake-triggered hazards, expected loss from a collateral earthquake hazard and hazard uncertainty, expected return on investment and uncertainty in mitigation, expected community wealth and uncertainty

Methodology data requirements: Earth science, economics, land use data, and regulatory standards or guidelines where applicable.

Direct participants in the application of the model of the vulnerability assessment:

Local, County, State/Provincial, Subnational (regional), and National Governments
Multilateral Development Agency
Private Consulting Firm
Multilateral Finance Agency
Bilateral Development Agency
Non Governmental Organization
Private Volunteer Organization
Research/Training Institute

Economic and social sector participants directly involved: --

Methodology objective: Risk communication using an expected value/variance decision criterion for hazards mitigation instead of an expected value alone as a decision making tool. Construct Decision Support System that provides rapid answers and is inexpensive to use in a geographic information system to assess community hazard vulnerability and risk at a spatial resolution that is appropriate for public decision-making. Evaluate alternative mitigation policies in the DSS that enables consensus building and cooperative decision-making in choosing an earthquake mitigation strategy.

Methodology output: User defined applications of mitigation strategies that provides hazard and risk maps, expected return on investment maps, expected wealth maps, GIS, statistical results of model runs.

Results of methodology application at case study site: Maps of earthquake-triggered liquefaction hazards and uncertainty and mitigation priorities at a community scale. Economic

payoffs from alternative mitigation policies varied over an order of magnitude less than the economic investment in structural mitigation for the earthquake scenario. Decision support system was used to assess three alternative mitigation policies. DSS can be used to customize decision makers' preferences. Model is expandable to multiple hazards and can be applied in different regions.

Lessons learned: A community-scale decision support system can be cheap to use, and can retain reasonable geographic discrimination to test alternative mitigation policies. Mitigation strategies can be designed differentially to suit the particular social organization of a community, i.e., a strategy can vary across a city.